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Unified Vision 2018 analyses

— organizational, cultural, and individual factors

Anne Lise Bjørnstad

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Summary

This report describes the results from the statistical analyses of the organizational, cultural, and individual factors measured at the joint intelligence, surveillance, and reconnaissance (JISR) exercise Unified Vision 2018 (UV18). The data analyzed in this report were collected through self-report surveys administered before and after the exercise by the NATO Human Factors and Medicine (HFM) Research and Technology Group (RTG) 276, entitled *Human Factors and ISR Concept Development and Evaluation*.

The research reported here is deemed useful for military decision-makers and researchers in command and control (C2), intelligence, surveillance and reconnaissance (ISR), organization, and human factors related research. The theory and results contribute to increasing the general understanding of individual, organizational, and cultural issues relevant for improving the effectiveness of military C2 and ISR. The method expands the available metrics for collecting relevant data on human issues related to C2 in ISR operations both nationally and internationally. Human issues includes both organization and processes.

Decision making taps into the perception of the C2 processes in the ISR organization. The results suggested that decision-makers generally had the means and capacity to make timely and good decisions during the UV18 exercise. In line with previous research from military settings, information sharing was found to be positively linked to decision making and shared awareness. This finding underscores the importance of facilitating information sharing and the understanding of roles and responsibilities both within and across the organizational components analyzed (the PED-cells, i.e., the processing, exploiting, and disseminating cells) to assure the effectiveness of the organization's C2 and ISR decision-making processes.

Trust related positively to the organizational output, in terms of shared awareness and decision making. Overall, the trust scores indicated good trust in other exercise personnel. However, the trust levels were lower post exercise than pre exercise, and lower across than within the PED-cells. Similarly, competence and shared awareness were rated lower across than within PED-cells, suggesting that commanders need to pay special attention to building trust and understanding across organizational components to improve the C2 effectiveness in ISR operations.

The personnel perceived the structure of the organization to be more hierarchic than flat. The results further suggested that there is room for improvement in future UV exercises pertaining to the technological solutions and procedures used. Finally, the results indicated that cultural differences may have an impact on the tendency for the individuals in a society to like to think in depth about issues (in terms of need for cognition, NFC).

The research presented in this report is limited by two main circumstances. First, the sample was limited in size, which restricted the statistical analyses possible. Second, on-site changes were made to the questionnaire, which may have hampered the validity and reliability of some of the measures.

Sammendrag

Denne rapporten beskriver resultatene fra de statistiske analysene av de organisasjonelle, kulturelle og individuelle faktorene målt under JISR (*joint intelligence, surveillance, and reconnaissance*)-øvelsen Unified Vision 2018 (UV18). Dataene analysert i denne rapporten ble samlet inn gjennom spørreskjema før og etter øvelsen av NATO-gruppen *Human Factors and Medicine (HFM) Research and Technology Group (RTG) 276, Human Factors and ISR Concept Development and Evaluation*.

Forskningsresultatene formodes å være nyttige for militære beslutningstakere og forskere innenfor kommando og kontroll (K2), *intelligence, surveillance and reconnaissance* (ISR), organisasjon og menneskelige faktorer. Teorien og resultatene bidrar til å øke den generelle forståelsen av individuelle, organisasjonelle og kulturelle faktorer med betydning for effektiviteten i militær K2 og ISR. Metodisk bidrar rapporten med måleinstrumenter (spørreskjema) til å samle inn relevante data på menneskelige faktorer relatert til K2 i ISR-operasjoner nasjonalt og internasjonalt. Menneskelige faktorer inkluderer både organisasjon og prosesser.

Beslutningstagning berører oppfattelsen av K2-prosessene i ISR-organisasjonen. Resultatene indikerte at beslutningstagerne generelt hadde midlene og kapasiteten til å ta tidsriktige og gode beslutninger under UV18-øvelsen. I tråd med tidligere forskning fra militære sammenhenger, ble informasjonsdeling funnet å være positivt relatert til beslutningstagning og felles forståelse av roller og ansvar. Funnet understreker viktigheten av å legge til rette for informasjonsdeling og felles forståelse både internt i, og på tvers av, de analyserte organisasjonskomponentene, PED-cellene (*processing, exploiting, and disseminating*), for å sikre effektivitet i organisasjonens K2- og ISR-beslutningsprosesser.

Tillit relaterte positivt til organisasjonseffektivitetsmålene, felles forståelse og beslutningstagning. Overordnet indikerte tillitsskårene god tillit til annet øvelsespersonell. Men tillitsnivåene ble funnet å være lavere etter enn før øvelsen og lavere på tvers av enn internt i PED-cellene. På lignende måte vurderte øvelsesdeltagerne kompetanse og felles forståelse som lavere på tvers av enn internt i PED-cellene, en indikasjon på at militære ledere bør jobbe spesielt for å bygge tillit og forståelse på tvers av organisasjonskomponentene for å bedre K2-effektiviteten i ISR-operasjoner.

Personellet oppfattet organisasjonsstrukturen som mer hierarkisk enn flat. Videre indikerte resultatene at det er rom for forbedring i teknologiske løsninger og prosedyrer for fremtidige UV-øvelser. Resultatene tydet også på at kulturelle forskjeller kan påvirke individenes tendens til å like å tenke i dybden (målt som *need for cognition, NFC*) i et samfunn.

Forskningen presentert i denne rapporten har to hovedbegrensninger. For det første var utvalgsstørrelsen noe knapp, hvilket la begrensninger på hvilke statistiske analyser som var mulige. For det andre ble det gjort endringer i spørreskjemaet på stedet, noe som kan ha svekket validiteten og reliabiliteten til noen av målene.

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Preface

This report presents the results from the statistical analyses of organizational, cultural, and individual factors measured during the joint intelligence, surveillance, and reconnaissance (JISR) exercise Unified Vision 2018 (UV18). The data collection was completed as part of the NATO Human Factors and Medicine (HFM) Research and Technology Group (RTG) 276, entitled *Human Factors and ISR Concept Development and Evaluation* work. A complete presentation of the analyses of all the data from UV18 collected by HFM-276 will be published in a NATO STO Technical report at the termination of HFM-276 (Spring 2020).

The work presented in this report contributes to the now terminated FFI project *Bistand til Forsvaret og Forsvarsdepartementet innen strategisk kommunikasjon* (BISK) and the current FFI project *Kommando, kontroll og teknologi i fellesoperasjoner* (K2).

Kjeller, 15 January 2020

Anne Lise Bjørnstad



1 Introduction

Military organizations are facing an increasingly wide spectrum of threats, of which cyber and hybrid threats are very central. As the wealth of information and complexity of threats increase, the sharing of information and the awareness and understanding of tasks and responsibilities in the organization is increasingly essential for good decision making and organizational effectiveness (e.g., Bjørnstad & Ulleberg, submitted; STO-TR-SAS-085, 2014) - in turn also affecting the organization's ability to reach its goals (e.g., Alberts, 2011; Kozłowski & Ilgen, 2005; STO-TR-SAS-085, 2014). This includes the organization's ability to withstand hostile activities aimed at breaking down its ability to communicate, share, and understand information correctly. Moreover, efficient organizational processes are understood to be central to intelligence, surveillance and reconnaissance (ISR), and command and control (C2), which in turn are essential in handling both traditional military, and cyber and hybrid threats. Cyber and hybrid threats are understood as threats to technologically based information systems or computer networks and threats that are not included in the conventional understandings of war, including influence operations.

1.1 Usability

The research reported here is deemed useful for military decision-makers and researchers in C2, ISR, organization, and human factors (HF) related research. The theory and results contribute to increasing the general understanding of individual, organizational, and cultural issues in military C2 and ISR relevant for improving the effectiveness and robustness of military C2 and ISR. The method expands the available metrics for collecting relevant data to improve our knowledge of human issues related to C2 in ISR operations both nationally and internationally. Human issues includes both organization and processes.

1.2 The FFI context and relevance for the Norwegian Armed Forces

The work presented here was mainly conducted as part of the FFI project *Bistand til Forsvaret og Forsvarsdepartementet innen strategisk kommunikasjon*¹ (BISK), but has been finalized within the FFI project *Kommando, kontroll og teknologi i fellesoperasjoner*² (K2). Consequently, the report refers to issues relevant to both these projects. Moreover, the variables analyzed are hypothesized to have an impact both on command and control/organizational effectiveness and on organizational robustness towards influence.

The K2 project is tasked with supporting the Norwegian Armed Forces at headquarter (HQ) level of command in their efforts to develop and maintain an effective organization and C2 processes – both internally and across to the tactical commands. The Norwegian HQ level of

¹ This project title translates to: Support to the Norwegian Armed Forces and Ministry of Defense in strategic communication.

² This project title translates to: Command, control, and technology in joint operations.

command is deeply involved in the ISR processes and also took part in the exercise where the data analyzed in this report were collected (i.e., Unified Vision 2018). The ISR organization and processes also involve cooperation between tactical and HQ levels of command, which also adheres to the K2-project focus. The research reported here is therefore deemed valuable for the Norwegian Armed Forces HQ (FOH).

1.3 Background, issues, and approach

ISR is about collecting and providing information to human operators who make decisions concerning various courses of action in their theatre of operations. Although humans are at the center of ISR processes, ISR has thus far almost exclusively been studied from a technological perspective (e.g., Bakdash, Pizzocaro, & Preece, 2013). This is true for the research on ISR in general, including both the research at FFI and in the NATO Science and Technology Organization (STO) organization. Consequently, there is a research gap in human factor issues related to ISR. The NATO STO Human Factors and Medicine Panel (HFM) Research Task Group (RTG) –276 (NATO RTG HFM 276, henceforth referred to as HFM-276) titled *Human Factors and ISR Concept Development and Evaluation* was established to identify and understand HF issues central to effective ISR operations. The goals of this group include developing an understanding of human factors issues and developing a methodology for studying HF issues relevant for ISR environments. Lichacz & Jassemi-Zargani (2016) deemed that a HF research methodology should be an integral part of ISR concept development and experimentation (CD&E), in order to inform and advise policy and decision-makers at all levels of the ISR chain of command.

ISR is an integral part of C2 as C2 is an integral part of ISR. For instance, information is central for decision making in a C2 context, and decision making is central in the handling of information and resources to gather information as well as to decide courses of action based on the information collected. C2 is a wide term in military contexts; this report focuses on the human side of C2 – on the organizational, cultural, and individual processes underlying decision-making processes in military operations.

Although human factors issues have been missing in ISR research, the C2 research at FFI and in NATO STO have included such a focus (e.g., Bjørnstad, 2005, 2011, 2013; Bjørnstad & Elstad, 2015; Elstad, Bjørnstad, Valaker & Hafnor, 2015; Sutton et al., 2008; Yanakiev & Horton, 2012). It is considered that this research on organizational, cultural, and individual issues related to C2 is relevant also for an ISR context. Consequently, the research presented in this report builds on both FFI and NATO STO research on human factor issues.

In order to better understand the organizational, cultural and individual issues related to ISR and C2 in a military context, there was a need to study these issues in relevant military contexts. HFM-276 worked to find a data collection venue relevant for the study of HF issues in ISR contexts and developed a plan for the collection of data. HFM-276 landed on the exercise series Unified Vision, which has become NATO's main exercise series to practice and evaluate new technical and operational concepts for conducting Joint ISR (JISR) in NATO operations. A

survey instrument was developed and data were collected before, under, and after the military exercise Unified Vision 2018 (UV18).

This report presents the results from the statistical analyses of organizational, cultural, and individual factors measured during UV18. The data collection was completed as part of the HFM-276 work. A complete presentation of the analyses of all the data from UV18 collected by HFM-276 will be published in a NATO STO Technical report at the termination of HFM-276 (Spring 2020).

1.4 Report overview

The report starts with a presentation of relevant theory, followed by a method section that describes the data collection venue and setting, the metrics, the procedures, and the sample. The results of the statistical analyses are presented in the subsequent results section. Finally, in the discussion section, the interpretations of the results are discussed, including also a discussion of its relevance and implications for ISR and C2. The results section does not contain the interpretations of the results; please be referred to the discussion section for this.

1.5 Limitations and related work

The main focus of this report is to describe the results of the statistical analyses of the data pertaining to organizational, cultural, and individual issues collected in UV18. The NATO report from HFM-276 will have a more elaborated method section describing the UV18 exercise in more detail, and will also include the analyses of other human factor issues. More in depth theoretical considerations from the angle of influence in a defense context, pertaining to several of the variables included the organizational model presented in the subsequent theory section (especially the individual and cultural factors), can be found in FFI report 19/01224 (*Understanding communication and influence in a defense context: A review of relevant research from the field of psychology*), by Anne Lise Bjørnstad. For a more in depth presentation of the organizational factors, see for instance Bjørnstad (2011, 2013) and Bjørnstad & Elstad (2015).

As is described in the method section (3), the sample size limits the possibilities of more advanced statistical analyses. There were also some challenges during the data collection that may have hampered the interpretability of some of the results. Hence, the research is not conclusive – further research will be needed. However, it is deemed that the current research is an important and relevant first cut on better understanding organizational, cultural, and individual issues in C2 and ISR contexts.

2 Theory

As indicated in the introduction, military organizations need to respond to a wide spectrum of threats and efficient organizational processes are understood to be central to both C2 and ISR. Previous research has pointed to organizational factors that are linked to organizational effectiveness. The literature also indicate that the organizational factors are linked to or are dependent on cultural and individual factors. This section presents the literature that underpins the organizational, cultural, and individual factors suggested to have an impact on the effectiveness of the organization.

2.1 Organizational effectiveness

In line with the suggestions of Kozlowski & Ilgen (2005), *organizational effectiveness* is understood as key organizational processes, operationalized as *shared awareness* of tasks and responsibilities, *information sharing*, and *decision making*, which in previous research have been linked to organizational output (e.g., Benbasat & Lim, 1993; Bjørnstad, 2011; Mesmer-Magnus & DeChurch, 2009; Riley, Endsley, Bolstad, & Cuevas, 2006). The definition of organizational effectiveness above, and the definitions of the organizational factors presented in the next chapter (Chapter 2.2) are in line with the definitions used in Bjørnstad (2011), Bjørnstad et al. (2013), and Bjørnstad & Ulleberg (submitted). The operationalization of organizational effectiveness represents the output/dependent variables in the current research. As indicated above, organizational effectiveness is understood to be central to C2 and ISR in military contexts, which in turn is essential in handling traditional military, and cyber and hybrid threats.

2.2 Organizational factors: Flat structure, decentralized processes, flexibility, alignment, trust, competence, and obstacles to information sharing

Being able to avoid erroneous decision making is a central part of good decision making. Research has shown that decentralized leadership and subordinates' propensity to question their superiors' decisions and take responsibility for their own actions to be essential in order to avoid erroneous decision making (e.g., Baran & Scott, 2010; Bienefeld & Grote, 2011, 2011b; O'Sullivan, Moneypenney, & McKimm, 2015). In a democratic organization, subordinates are more involved in the decision-making process and there is less distance between the upper and lower levels of the organization, both in terms of fewer levels in the hierarchy as well as in terms of the authority difference between these levels. Democratic organization should consequently make subordinates more motivated and less afraid to, question and contradict their superiors. Hence, democratic organization may be seen as an organizational means to minimize erroneous decision making. *Democratic organization* is understood to imply flat structure and decentralized organizational processes. *Flat structure* is in turn defined as the degree to which the organization may be understood as flat in terms of the number of hierarchical levels in the organization (e.g., Bjørnstad, 2011; Volberda, 1998). *Decentralized processes* mean shorter

information-sharing and decision-making loops (e.g., Roman, 1997). Whereas structure is understood as the formal hierarchical structure of the organization, processes is understood to describe how the structure is implemented in terms of collaborative and decision-making processes (Bjørnstad, 2011; DeSanctis & Poole, 1997).

Democratic organization may also be seen as an organizational means to enable personnel at all levels to reveal potential enemy activity aiming to gain unwanted influence, involving for instance the manipulation of information, and/or any infiltration in the organization. As suspicions of such activity may be somewhat uncertain at first, the feeling of being empowered and responsible is expected to motivate subordinates both to investigate and to inform their superiors of such suspicions at an early stage.

Research from military exercises in both national (i.e., Norwegian) and international contexts at both lower (tactical) and higher (operational) hierarchical organizational levels, linked flatter hierarchies and more decentralized organizational processes (i.e., democratic organization) to more flexibility, better information sharing, higher awareness of tasks and responsibilities, and better decision making (Bjørnstad, 2011). *Flexibility* is understood as the ability of the organization to respond successfully and adaptively to the complex, unpredictable and changing demands of the environment (Hatun & Pettigrew, 2006). However, research from a different international military exercise had more mixed results (Yanakiev & Horton, 2012); this research failed to find the positive relationship between decentralized processes and effective organizational processes.

The positive relationship between flat structure and flexibility was in the research edited by Yanakiev and Horton (2012) also found to be moderated by a cultural difference in power distance (i.e., “the extent to which the less powerful members of institutions and organizations within a country expect and accept power to be distributed unequally”; Hofstede, 1991: p. 28), in terms of the relationship only being significant in low power distance (Pd) cultures. Hence, cultural differences may be an important factor in defining the organizational characteristics that lead to more effective organization and C2 in military contexts. This is in line with the theory and research from cross-cultural organizational psychology (e.g., Hofstede, 2001).

The successful handing down of authority to lower levels of command and a decentralization of organizational processes in military and other organizations may also depend on other critical issues such as alignment between structure and processes, trust, competence, and obstacles to information sharing, which in separate lines of research have been found to affect key organizational processes and outcomes (e.g., Bjørnstad, 2011; Bjørnstad, Fostervold & Ulleberg, 2013; Bjørnstad & Lichacz, 2013; Breuer, Hüffmeier, & Hertel, 2016; Colquitt, Scott, & LePine, 2007; De Jong, Dirks and Gillespie, 2016; Dirks & Ferrin, 2002; Hirschfeld, Jordan, Feild, Giles, & Armenakis, 2006; Mathieu, Kukenberger, D’Innocenzo, & Reilly, 2015; Valaker et al., 2016). Indeed, more recent survey data from a Norwegian military organization, suggest that flat structure, decentralized processes, alignment between structure and processes, flexibility, competence, trust, and few obstacles to information sharing positively influence organizational effectiveness (Bjørnstad & Ulleberg, submitted).

Alignment is understood as the congruence between the organization's structure and processes (Bjørnstad, 2011); meaning that a combination of flat structure and decentralized processes would indicate high alignment, whereas a combination of flat structure and centralized processes would indicate low alignment. Rousseau, Sitkin, Burt, and Camerer suggested in 1998 (p. 395) a cross-disciplinary definition of *trust*, which has been understood in later research to include the most essential elements of trust (e.g., Burke et al., 2007; De Jong, et al., 2016; Dirks & Ferrin, 2002): "Trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another". *Competence* is defined as the knowledge and task-related ability to conduct the job. This definition builds on Brooking (1996) and reflects the scope of this research, the exercise aims, and the respondents. Based on the work by Bjørnstad (2005), Bjørnstad & Elstad (2015), and Lichacz & Bjørnstad (2013), *obstacles to information sharing* is defined as organizational, technological, and security-based constraints that are perceived by the organization's members to provide hindrances to their sharing of information.

2.3 Cultural Factors: Power distance (Pd) and uncertainty avoidance (Ua)

In this study, *culture* is defined as national culture, which concurs with the current scope and the field of cross-cultural psychology (e.g., Hofstede, 2001; House, Hanges, Javidan, Dorfman, & Gupta, 2004; Inglehart, Basáñez, Díez-Medrano, Halman, & Luijkx, 2004; Schwartz & Sagiv, 1995).

Cultural differences in *power distance* (Pd) influence whether people from different countries are accustomed to and prefer to work in more hierarchical and centralized types of organizations or, conversely, whether they are accustomed to and prefer to work in flatter and more decentralized types of organizations (e.g., Hofstede, 2001). Cultural differences in Pd have been found to influence the organization and decision-making processes (e.g., Bjørnstad & Lichacz, 2013; Yanakiev & Horton; 2012; Hofstede, 2001). A high power distance culture makes it less acceptable, and therefore more difficult, for subordinates to question superiors' decisions. In line with this, high power distance has been linked to erroneous decision making in high-risk environments (e.g., O'Sullivan, et al., 2015). Hierarchy plays a more central role in organizations in high power distance cultures, and power distance may as such be understood as a cultural vulnerability to erroneous decision making.

Uncertainty avoidance (Ua) is defined as the extent to which the members of institutions and organizations within a society feel threatened by uncertain, unknown, ambiguous, or unstructured situations (Hofstede, 2001). In high Ua cultures ambiguity is avoided and rules play a more important role (Hofstede, 2001).

Pd and Ua are assumed to be the most relevant cross-cultural differences that may affect the organizational processes in a NATO collaborative setting like the UV18. Research has indicated that Pd and Ua are central constructs and valid measures of national differences also in military settings (Soeters, 1997; Bjørnstad & Ulleberg, 2017). However, there are some doubts about the

validity of Hofstede's other dimensions (individualism and masculinity) in military contexts (Bjørnstad, 2013; Bjørnstad & Ulleberg, 2017).

2.4 Individual factors: Need for cognition (NFC) and Job involvement

Need for cognition (NFC) refers to individual differences in the tendency towards engaging in and enjoying effortful cognitive endeavors (Cacioppo, Petty & Kao, 1984). NFC has been found to predict performance on cognitive tasks and is furthermore understood as either a predisposition for, or a central part of critical thinking (e.g., Fischer, Spiker, & Riedel, 2009; Heijltjes, van Gog, Leppink, & Paas, 2014; Klaczynski, Fauth, & Swanger, 1998). Definitions of critical thinking include such mental processes as reflection, questioning, logic, reasoning, meta-cognition, and making judgements (for an overview, see e.g., Fischer, et al., 2009). Critical thinking has in turn been deemed a pivotal capacity in military leaders and personnel, central to their interpretation of information and decision making (e.g., Fischer, et al., 2009).

A high level of NFC among the organizational members may be expected to give more effective organizational processes in terms of higher shared awareness, information sharing, and decision making due to more cognitive elaboration and central processing of information (i.e., systematic and in-depth cognitive processes; e.g., Fiske & Taylor, 2017; Petty & Wegener, 1999). Additionally, an organization high in NFC may be more resilient to enemy attempts at negative influence and destabilization by for instance disinformation (i.e., information that may be anything from unfortunate to inaccurate to blatantly untrue), because they will tend to seek out information from more sources and more closely evaluate the truth in the messages sent out relative to those lower on NFC. Indeed, NFC has also been shown to affect the degree to which, and the manners in which, persons are susceptible to persuasion (Cacioppo, et al., 1984; Haugtvedt & Petty, 1992). NFC is therefore deemed important in a defense organizational context – in terms of both being a capacity for C2 and in creating robustness towards enemy attempts at influence. Consequently, it would seem advantageous to foster military organizations where the qualities of NFC are boosted rather than subdued.

Because more responsibility is distributed to the lower levels in the hierarchy in democratic organizational forms, personnel at the lower levels become more involved in the decision-making processes compared to those in more hierarchic and centralized organizational forms. Moreover, there are more factors motivating subordinates to think for themselves in a democratic type of organization. A democratic organization may therefore be understood to promote a culture where there is a high level of NFC, and hence, high probability of elaboration in the organizational members' cognitive processes.

NFC has been regarded as a personal trait, that is, a stable personal tendency not subject to situational influences. However, because a trait is formed by an individual's upbringing, education, and societal experiences, there is reason to believe that the organizational and cultural context, in which individuals work and live, also may exert some effect on a person's level of NFC. For instance, one could imagine that authoritarian and strongly rule-based cultures (i.e., high in Pd and Ua) and hierarchic and centralized organizations would be

promoting lower NFC in individuals than democratic and flexible organizations and culture. In organizations, the level of NFC may be affected both through self-selection and in terms of a strengthening or weakening of the personal tendency to engage in effortful thinking. Hence, although considered a personal trait, NFC is expected to be influenced by a number of life experiences. The related concept of critical thinking introduced above, has similarly been viewed as both an ability that can be learned and trained, and as a personal predisposition (e.g., Fischer, et al., 2009). There is a need for research that further explore the antecedents of NFC and its malleability in terms of contextual influences. The research reported here is a first small step, where its relationships with some central cultural and organizational factors are explored.

Job involvement as a concept was launched by Lodahl & Kejner in 1965, but has since then been both defined and assessed in various ways, focusing on the job's influence on a person's self-esteem (Lodahl & Kejner, 1965), identity (Lawler & Hall, 1970), or cognitive identification with work (Kanungo, 1979). Paullay, Alliger, and Stone-Romero (1994) defined job involvement as the cognitive preoccupation and engagement with, and concern for one's present job. Related constructs like *work centrality* and *work commitment* refer to attitudes and orientations to work in general (Paullay et al, 1994), while *organizational commitment* refers to the specific commitment or emotional attachment that employees have to their organization (e.g., Mayer & Schoorman, 1998). All these concepts have been found to be highly related but distinct constructs in several studies (Brown, 1996; Cooper-Hakim & Viswesvaran, 2005; Halberg & Schaufeli, 2006; Mathieu & Farr, 1991). Brown (1996), Butts, Vandenberg, DeJoy, Schaffer, and Wilson (2009), and Halberg & Schaufeli (2006) furthermore found all these concepts to be positively related to a high degree of autonomy in the workplace – that is, a decentralized organization. Job involvement has been found to influence the effort put into one's job (Brown, 1996), and can as such be understood as a work motivational factor (Moynihan & Pandey, 2007). Because job involvement has been found to promote job effort and motivation, in turn also fostering cognitive elaboration (e.g., Fiske & Taylor, 2017; Petty & Wegener, 1999), job involvement is expected to promote organizational and C2 effectiveness and robustness against enemy influence.

2.5 Organizational model

Building on the research presented above, most notably Bjørnstad (2011) and Bjørnstad & Ulleberg (Submitted), an organizational model has been developed in the context of HFM-276 (Bjørnstad, in progress; Lichacz, Valaker, Zelik, Bjørnstad, & Stensrud, in progress). The model (Figure 4.1) attempts to describe the relationships between the factors presented above in this chapter, factors that are anticipated to be central in making a military organization efficient (understood as a basis for good C2 and robustness towards influence) in both traditional and hybrid threat contexts. The literature presented in this chapter suggest that democratic organization, defined as flat structure and decentralized organizational processes, has both direct and indirect positive effects on organizational effectiveness. Organizational effectiveness is operationalized as shared awareness, information sharing, and decision making in the model (for more on this, see Bjørnstad, 2011; Bjørnstad & Ulleberg, Submitted). Job involvement and NFC are the two central individual level factors included in the model, both understood to be

mediating factors, that is, mediating the effects of structure and processes on the organizational variables. Similarly, obstacles to information sharing and flexibility are understood to be mediating factors. Power distance (Pd) and uncertainty avoidance (Ua) represent the cultural context factors, which are anticipated to moderate the effects of organizational structure and processes on the organizational effectiveness variables. This means that the effectiveness of for instance flat structure and decentralized processes is expected to be dependent on the cultural context being low Pd and Ua. Pd is also viewed as an independent variable, meaning that a low Pd cultural context is increasing the likelihood of the organization being flat and decentralized. The alignment of structure and processes is also expected to moderate the effects of structure and processes on the effects variables. This means that if structure and processes are not aligned, flat structure may not have a positive effect on the effectiveness variables. Trust and competence represent both independent variables and moderators in the model. This means that for instance trust is expected to have both an independent direct positive effect on organizational effectiveness as well as moderating the effects of structure and processes on flexibility and organizational effectiveness.

The model is included in this report to visualize the expected interconnections between the individual, organizational, and cultural factors and to show how they are anticipated to be linked to organizational effectiveness. It aims to enlighten the reader on the interconnections between the factors and on the importance of each factor for the organizational effectiveness. This contributes to understanding the context of the inclusion of each variable in the survey. However, the data collected in UV18 are not sufficient in numbers to be able to test the whole model; subsequent data collections will be needed to provide a larger and more complete data set that will allow such advanced analyses. For a more in depth description of the basis for the model and of the factors less focused on here, please be referred to the cited research (e.g., Bjørnstad, 2011; Bjørnstad & Lichacz, 2013; Bjørnstad & Ulleberg, Submitted; Bjørnstad, in progress; Lichacz et al., in progress).

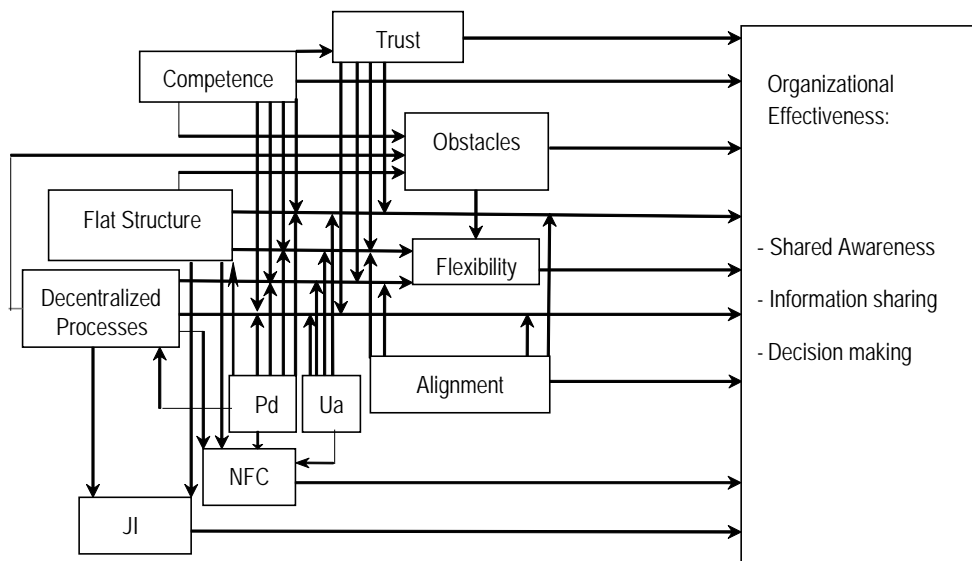


Figure 2.1 Organizational model of effectiveness (*JI* = job involvement, *NFC* = need for cognition, *Ua* = uncertainty avoidance, *Pd* = power distance, *Obstacles* = obstacles to information sharing, and *Alignment* = alignment of structure and processes). All lines indicate hypothesized relationships, of which all are positive except the relationships of obstacles to information sharing, the relationships of *Pd*, and the relationships of *Ua*.

3 Method

3.1 Data collection venue, method, and procedures

The data were collected at United States Air Forces Europe Warrior Preparation Centre (USAFE WPC), in Einsiedlerhof, Germany, in connection with the military exercise UV18 by members of HFM-276, June 11-26 2018. The general aim of the UV18 was to improve NATO joint ISR interoperability and address the improvements needs identified in previous UV trials (i.e., exercises). This implied a focus on interoperability between NATO and national JISR capabilities to improve the process of tasking, collecting, processing, exploiting, and disseminating (TCPED) intelligence data. The operational components (i.e., organizational subdivisions) involved in this work are referred to as PED (processing, exploiting, and disseminating) cells. The UV series of exercises is a central arena for NATO’s practice and evaluation of new technical and operational concepts for conducting JISR in NATO operations. The UV18 exercise was geographically distributed with nodes in for instance Italy, France, the

Netherlands, the Czech Republic, the USA, and Norway. Please be referred to the coming HFM-276 final report for more details on the exercise and the venue.

Self-report questionnaires were distributed electronically to exercise personnel right before the onset of and at the completion of the exercise, henceforth named the pre and post exercise questionnaires respectively. There were also five daily surveys distributed during the exercise from the HFM-276 group; these are not at the focus of this report and will thus not be described here. The surveys presented here were part of a large battery of instruments from different research and analyst groups that were distributed to the participants of UV18.

The original pre and post exercise questionnaires are included in the Appendix (Chapters A.1 & A.3), alongside the final version of the measures that the analyses described in this report are based on (Chapters A.2 & A.4). There were some changes made on site based on a demand from the military lead/participants. This meant a shortening of the post exercise questionnaire, so that some measures were cut altogether (job involvement), while others were abbreviated (decentralized processes, flexibility, trust, shared awareness, and decision making) – some down to single-item measures (competence).

3.2 Sample

The sample consisted of military personnel participating in UV18. All were participating on a free-will basis. 53 answered the pre exercise survey, while 32 answered the post exercise survey. The sample consisted of participants from 13 different countries (the first and second number in parenthesis represents the number of respondents from each country having completed the pre-exercise and post-exercise surveys respectively): USA (13/6), Spain (11/8), Croatia (7/5), Czech Republic (5/4), Germany (4/3), Italy (3/2), Belgium (2/0), Poland (2/1), France (2/1), Romania (1/0), Slovenia (1/1), Turkey (1/0), and Great Britain (0/1). Demographics of the participants will be further detailed in the announced NATO STO final report from HFM-276. Measures³ that had incomplete answers, meaning that there were missing values on one or more items⁴, were not included in the analyses.

3.3 Metrics

The measures used to assess the variables⁵ described in the theory section, were based on existing measures, some slightly altered to fit the UV18 context.

The organizational variables, *flat structure*, *decentralized processes*, *flexibility*, *alignment*, *obstacles to information sharing*, *trust*, and the organizational effectiveness variables, *shared awareness of tasks and responsibilities*, *information sharing*, and *decision making* were all assessed using scales developed for use in military contexts and whose psychometric properties

³ A measure in a questionnaire refers to the set of questions/items and their response categories that are used to assess any given construct on any given scale. Measure and metric are used interchangeably.

⁴ I.e., questions.

⁵ I.e., constructs.

were tested in Bjørnstad & Elstad (2015). These measures were based on earlier work by Bjørnstad, Fostervold, & Ulleberg (2013), Lichacz & Bjørnstad (2013), Bjørnstad (2005, 2011), and Yanakiev & Horton (2012). Alignment is calculated and represents the absolute difference in scores between the flat structure and the decentralized processes measures. For instance, a high flat structure score of 5 combined with a low processes score of 1 (i.e., centralized processes) would yield an alignment score of 4, indicating low alignment. *Obstacles to information sharing* was assessed using an adaption of Bjørnstad's measure (2005; Sutton et al., 2008; Lichacz & Bjørnstad, 2013; Bjørnstad & Elstad, 2015), and *trust* was assessed using the measure from Bjørnstad et al., (2013). The measure of *competence* was based on Bjørnstad & Ulleberg (submitted). All these measures are used and described in Bjørnstad & Ulleberg (submitted). Trust, competence, and shared awareness were assessed in relation to both the respondents' own PED-cell/operational component and in relation to the other PED-cells/operational components. Trust was additionally assessed both pre and post exercise.

We assessed need for cognition (NFC), using the NFC measure developed by Cacioppo et al. (1984). The cultural differences, power distance (Pd) and uncertainty avoidance (Ua), were assessed using Hofstede's Values Survey Module, VSM 2013 (available at www.geerthofstede.com). There are research supporting that the Pd and Ua measures are valid also in military settings (Soeters, 1997; Bjørnstad, 2013).

Response categories⁶ were on five-point scales. Some items were recoded in order to make high scores indicate the same across items and measures. The cultural measures were calculated using Hofstede's formulae (www.geerthofstede.com): $Pd = 35(m07 - m02) + 25(m20 - m23) + C(pd)$ and $Ua = 40(m18 - m15) + 25(m21 - m24) + C(ua)$. In this formulae "m" is the mean score on the numbered item, the numbers outside the parenthesis are constants that Hofstede estimated in his calculations, and "C" is a constant that may be added to make the scores between 0 and 100.

As indicated above, HFM-276 members on site were charged with shortening the post-exercise questionnaire. This meant that the job involvement measure was cut altogether, and the competence measure was cut down to a single-item measure. Furthermore, the decentralization, flexibility, trust, shared awareness, and decision-making measures were each abbreviated with one item. There were also made changes in wording to some of the measures, notably to the flat structure, decentralization, flexibility, and decision-making measures. The flat structure, decentralization, and flexibility measures had "organization" exchanged with "organizational structure". This change was unfortunate, as it may have served to confuse the respondents in separating between the organizational structure (flat structure) and process measures (decentralization and flexibility).

In addition to cutting the decision-making down to a two-item measure, the response categories of the first item was changed so that in effect two of the response categories on the five-point scale were cut. This was unfortunate. Consequently, the scale had to be recoded to a scale with

⁶ I.e., answer choices.

the values 1, 3, and 5, to make it fit the other five-point scale item in the measure. As indicated above, the final versions of the pre and post questionnaires are included in the Appendix (A.2 & A.4).

4 Results

The results of the statistical analyses are presented in this section. Please be referred to the discussion section for the interpretations and implications of the results.

The presentation of results starts with a basic analysis of all the variables, presented subsequently under the descriptive analyses headline (Chapter 4.1). Following the results from the descriptive analyses are more in-depth analyses of the variables based on the results of the descriptives. Hence, subsequently Chapter 4.2 presents the organization structure and processes measures, Chapter 4.3 the cultural measures, Chapter 4.4 obstacles to information sharing, Chapter 4.5 shared awareness, Chapter 4.6 competence, and Chapter 4.7 trust. The competence and trust chapters include comparative analyses of competence and trust rated within the PED-cells/operational component as opposed to across PED-cells/operational components. The trust Chapter also includes comparative analyses of trust measured before the exercise and trust measured after the exercise. The variable relationships were then explored by a correlation analysis (presented in Chapter 4.8), and possible moderator effects on these relationships were explored by the moderator analyses (presented in Chapter 4.9).

4.1 Descriptive analyses

Descriptive analyses were conducted first, to give an overview of all the variables and the scores — their means (M), standard deviations (SD), reliabilities (Alpha),⁷ and number of responses (N). The results of the descriptive analyses are presented in Table 4.1. As indicated above, follow-up analyses including more detailed analyses ensues in the subsequent chapters.

⁷ The mean (M) is the average score, the standard deviation (SD) is a measure of variation in scores across respondents, and Cronbach's Alpha (α) is a measure of reliability.

Table 4.1. Mean (*M*), standard deviation (*SD*), reliability (Cronbach's Alpha Based on Standardized Items), and number of responses (*N*)

	<i>M</i>	<i>SD</i>	Alpha (α)	<i>N</i>
1. Flat structure (5 items)	3.41	0.25	.60	28
2. Decentralized processes (4 items)	3.10	0.66	.80	31
3. Flexibility (4 items)	3.33	0.54	.64	31
4. NFC (19 items)	3.68	0.44	.84	40
5. Power distance (Pd) (4 items)	35.80	22.72	--	50
6. Uncertainty avoidance (Ua) (4 items)	102.17	60.12	--	52
7. Internal competence (1 item)	3.59	1.19	--	32
8. External competence (1 item)	3.19	1.05	--	31
9. PreEx internal trust (3 items)	3.99	0.87	.93	45
10. PreEx internal trust (2 items)	3.98	0.85	.86	45
11. PreEx external trust (3 items)	3.68	0.75	.93	44
12. PreEx external trust (2 items)	3.69	0.76	.93	45
13. PostEx internal trust (2 items)	3.14	0.72	.85	28
14. PostEx external trust (2 items)	3.03	0.71	.67	31
15. Obstacles to information sharing (14 items)	2.47	0.51	.80	30
16. Shared internal awareness (4 items)	3.53	0.77	.76	30
17. Shared internal awareness (3 items)	3.57	0.80	.65	31
18. Shared external awareness (3 items)	3.13	0.81	.70	30
19. Information sharing (3 items)	3.32	1.06	.88	32
20. Decision making (3 items)	3.73	0.86	.84	27

Note. All measures were rated on 5-point scales. NFC = need for cognition. "Internal" refers to own PED-cell/operational component, whereas "external" refers to other PED-cells/operational components.

"PreEx" refers to pre exercise and "postEx" refers to post exercise. The alpha could not be calculated for Pd, Ua, and competence; there were too few respondents from each country in regards to Pd and Ua, and competence had been cut down to a single-item measure in UV18. Due to the trust and shared awareness measures having been cut down with one item in the post-exercise survey, the pre-exercise measures of trust and the post-exercise measures of internal trust and shared awareness also had to be cut by the same item to make the measures comparable. The full measures (which are not comparable) are also listed to reveal whether the truncation resulted in a difference in mean, standard deviation or alpha.

With the exception of flat structure, flexibility, and one of the truncated trust (i.e., 2 items) and shared awareness (i.e., 3 items) measures, the measures demonstrated between acceptable ($\alpha > .70$) and very good ($\alpha > .90$) reliability. This means that most measures may be deemed reliable and hence the results from these may be deemed trustworthy. The competence measure was cut down from a four-item to a single-item measure, and the validity and reliability may thus have been compromised. The exceptions are presented more in depth in the subsequent chapters.

The highest mean scores were achieved for pre-exercise trust and decision making – just below four on the five-point scales used in the survey – indicating good trust and decision making. The lowest scores were obtained for flat structure (single-item; see Table 4.2) and the obstacles to information sharing measures. The scores were below average – right between the scores two and three, indicating a somewhat hierarchical structure and that the different obstacles were between rarely and sometimes a hindrance for information sharing.

4.2 Flat structure, decentralized processes, flexibility, and alignment

As presented in Table 4.1 (line 1), the flat structure full five-item measure demonstrated an unsatisfactory reliability estimate. Therefore, an if-item-deleted reliability analysis and a comparison of item means were conducted, as presented in Table 4.2. Comparing the means of the items within the measure revealed that the participants had rated the fifth item quite differently from the first four. Indeed, the “Corrected item-total correlation”-column in the table demonstrated that item five was negatively correlated with the other items in the measure. The “ α -if-item-deleted”-column in the table further revealed that removing this fifth item would help the reliability estimate well above the accepted .70 limit.

Examining the wording of the items reveal that, especially after the on-site item moderations, the rest of the items (i.e., items one to four) may be interpreted more in the direction of describing whether there was perceived to be a small or large *part* of the hierarchy included in the exercise, rather than saying something about whether the structure was interpreted to be hierarchic or flat in itself. Item five was closer to the original and more clearly about whether the part of the structure included was interpreted to be hierarchic or flat (i.e., irrespective of whether this could be considered a small or a large part). Based on these findings we conclude that item five best reflects the intended meaning of the flat structure measure, in line with previous research (Bjørnstad, 2011; Bjørnstad & Elstad, 2015; Bjørnstad & Ulleberg, submitted). This item has previously been validated and used as a single-item measure (Bjørnstad, 2011). However, in the subsequent analyses (correlations, Chapter 4.8) we have also included the mean of items one to four as a secondary measure of the hierarchy, but interpreted to mean whether a small or big part of the home organizations’ hierarchy was perceived to be included or not in the exercise. This variable is henceforth labelled “few levels included in the exercise”.

Table 4.2 Flat structure: Item mean (M), item Standard Deviation (SD), Corrected item-total correlation, and Alpha (α) if item deleted.

Items	M	SD	Corrected item-total correlation	α if item deleted
1. Work in this trial's organizational structure is concentrated within few hierarchical levels.	3.50	0.75	.44	.41
2. There are few decision-making levels within this trial's organizational structure.	3.75	0.52	.77	.30
3. Information needs to travel through few hierarchical levels in this trial's organizational structure.	3.64	0.78	.37	.46
4. Responsibility is distributed across a few hierarchical levels in this trial's organizational structure.	3.64	0.73	.70	.23
5. In general, how would you describe the organizational structure in this trial?	2.54	0.74	-.31	.81

Note. $N = 28$.

The decentralized processes and flexibility measures were, as indicated in the method section, cut with one item (the general item) and the meaning altered by exchanging “organization” with “organization structure” in all of the items of both measures. As indicated, this makes the results less interpretable, as the meaning has been blurred. Decentralization demonstrated good reliability, while flexibility was just below the .70 limit for acceptable reliability⁸. The lowered reliability score could be due to the changes in the measures, as described in the method section, compared to the original measure validated in previous research from military contexts (e.g., Bjørnstad & Elstad, 2015).

As indicated in the theory and method sections, alignment scores represent the difference between the flat structure and the decentralized processes scores in absolute values. The flat structure single-item (item 5) score was used to calculate the difference between flat structure and the decentralized processes. Descriptive analyses yielded an alignment mean score of 0.80 ($SD = 0.62$), indicating high alignment between organizational structure and processes.

4.3 Power distance (Pd) and uncertainty avoidance (Ua)

As indicated in the method section, Pd and Ua were calculated using Hofstede’s formulae (www.geerthofstede.com): $Pd = 35(m07 - m02) + 25(m20 - m23) + C(pd)$ and $Ua = 40(m18 - m15) + 25(m21 - m24) + C(Ua)$, where “m” is the mean score on the numbered item and “C” is

⁸ As the coefficient alpha is heavily dependent upon the number of items within the scale, low alpha values can be expected when few items are used to measure the construct of interest (i.e., variable). Although the alpha values ideally should have been higher, standards for acceptable reliability, such as .70 (Nunnally, 1978 p. 245) are conventions, and not clear cut-off criteria (for a discussion, see Pedhazur & Schmelkin, 1991 p. 109–110).

a constant that may be added to render Ua scores between 0 and 100. The constant “200” was thus added to make the scores positive and mainly also below 100. Because these measures are at the country level, we should have had a minimum sample of $n = 20$, preferably 50, per country in order to calculate the measures correctly (e.g., www.geerthofstede.com); we had between 1 and 13. The mean values calculated for each country are therefore deemed unreliable, and the current research means presented in Table 4.3 should be interpreted with great care. In order to calculate any relationships between Pd and Ua, and the organizational and individual measures, it will therefore be necessary to revert to using values from previous research⁹, such as Hofstede (1991) and Soeters (1997). Values from these studies were therefore included in Table 4.3¹⁰. Hofstede had the most complete sample of countries compared to the current sample, whereas Soeters had the most similar social cohort in his sample (i.e., from military academies). Mean values differ due to some changes in the scale used in the three studies, but the rank order¹¹ is comparable.

Table 4.3 Country power distance (Pd) and uncertainty avoidance (Ua): mean (M), rank order (RO), and sample size (n) from the current and previous data sets (IBM: Hofstede, 1991; Military Academies: Soeters, 1997).

NAT.	Pd						Ua							
	Current			Hofstede		Soeters		Current			Hofstede		Soeters	
	M	RO	n	M	RO	M	RO	M	RO	n	M	RO	M	RO
USA	59.00	2	13	40	3	84	6	74.25	8	13	46	12	72	5
ESP	9.35	10	11	57	8	92	5	113.70	3	11	86	5	89	1
CRO	41.80	5	7	73	2			90.65	5	7	80*	8		
CZE	20.00	9	5	57**	8			130.00	2	5	74**	10		
GER	46.25	4	4	35	11	63	7	85.00	6	4	65	11	75	3
ITA	7.50	11	3	50	10	114	3	10.00	12	3	75	9	86	2
BEL	50.00	3	2	65	7	95	4	50.00	11	2	94	1	74	4
POL	25.00	7	2	68**	4			95.00	4	2	93**	2		
ROU	25.00	7	1	90**	1			55.00	10	2	90**	3		
SLO	110.00	1	1	71*	3			65.00	9	1	88*	4		
TUR	35.00	6	1	66	6			80.00	7	1	85	7		
FR	--	--	--	68	4	116	2	360.00	1	2	86	5	71	6
GB	--	--	--	35	11	131	1	--	--	--	35	13	49	7

Notes. * = reanalysis of data (Hofstede, 2001), ** = estimated (Hofstede, 2001).

⁹ This is a very common method in cross-cultural psychology (e.g., Hofstede, 2001; Bjørnstad, 2013)

¹⁰ The table is not included for the purpose of any comparative analyses, but has a descriptive and informative function for understanding the context of the current and future research.

¹¹ I.e., countries ranked on the basis of the scores on the variables. This is commonly used in the field of cross-cultural psychology (e.g., Hofstede, 2001) in order to make results from different studies with differences in the metrics and societal cohorts comparable.

4.4 Obstacles to information sharing – details

As indicated in Table 4.1 (line 15), obstacles to information sharing demonstrated good reliability. However, the measure is also intended for use at the item level (e.g., Bjørnstad & Elstad, 2015). The item descriptive statistics are presented in Table 4.4. We see that technical and procedural difficulties represented the most important obstacles to information sharing. A mean score of 3.4 indicated that these obstacles were between sometimes and often perceived to be a hindrance for information sharing. Approachability of the commander and political constraints represented the least important constraints to information sharing. A mean score of 1.77 indicated that these obstacles rarely were perceived to be a hindrance for information sharing. None of the items had a very high mean score, just a bit above average at the most, which may be interpreted to mean that none of the measured obstacles represented a critical hindrance for information sharing.

Table 4.4 Obstacles to information sharing: Item means (*M*) and standard deviations (*SD*).

Items	<i>M</i>	<i>SD</i>
1. How often did technical difficulties represent an obstacle to information sharing during this trial?	3.40	1.10
2. How often did procedural inefficiencies represent an obstacle to information sharing during this trial?	3.40	0.89
3. How often did low English proficiency of participants represent an obstacle to information sharing during this trial?	2.17	0.99
4. How often did differences between PED-cells/operational components represent an obstacle to information sharing during this trial?	2.90	1.00
5. How often did differences in national culture represent an obstacle to information sharing during this trial?	2.13	1.22
6. How often did time constraints represent an obstacle to information sharing during this trial?	2.33	0.96
7. How often did the approachability of the commander represent an obstacle to information sharing during this trial?	1.77	0.82
8. How often did lacking knowledge about who needs the information represent an obstacle to information sharing during this trial?	2.83	0.99
9. How often did differing priorities represent an obstacle to information sharing during this trial?	2.77	0.94
10. How often did political constraints/control represent an obstacle to information sharing during this trial?	1.73	0.83
11. How often did security issues represent an obstacle to information sharing during this trial?	2.13	0.86
12. How often did document classification represent an obstacle to information sharing during this trial?	1.93	0.74

13. How often did system classification represent an obstacle to information sharing during this trial?	2.00	0.87
14. How often did mismatches between real world processes and the simulated processes represent an obstacle to information sharing during this trial?	3.07	1.02

Note. $N = 30$.

4.5 Shared Awareness

Shared awareness of tasks and responsibilities both within (internal) and across (external) PED-cells/operational components demonstrated mean scores above average (Table 4.1, lines 16–18).

As indicated in the method section, because the post-exercise survey exceeded acceptable length for the participants, we ended up with three instead of four items in the shared external awareness metric. The shared internal awareness was measured by the full four items, but had to be reduced by one item to make internal and external awareness comparable. Table 4.1 shows an acceptable reliability estimate for the original four-item measure of shared internal awareness (line 16), while reducing the measure to three items made reliability a bit below the commonly accepted $>.7$ limit (line 17). Subsequent research should therefore strive to use the whole measure to ensure acceptable reliability.

Comparing the scores for shared internal awareness and shared external awareness based on three items (Table 4.1, lines 16–17), revealed a difference in scores, indicating that there was a higher awareness of tasks and responsibilities within than across PED-cells/operational components (0.46 difference). Testing the significance of the difference using a Paired samples t-test¹² revealed that the difference was significant ($t = 2.86$, $df = 30$, $p = .008$)¹³, and calculating Cohen's d -value¹⁴ indicated that the difference was medium sized ($d = 0.52$).

4.6 Competence

As indicated above, competence was assessed by a single item. Most probably, cutting three of the four items may have hampered the reliability of the measure. It is recommended that future research use the whole measure.

Table 4.1 (lines 7–8) suggests that there might be a difference between the internal and external competence, that is, competence within PED-cells/operational components seemed to be rated higher than competence across PED-cells/operational components.

Testing the significance of the difference using a Paired samples t-test revealed that the difference in means (0.39) was marginally significant ($t = 2.04$, $df = 30$, $p = .050$). Calculating

¹² Paired samples t-test is an analysis that tests whether the difference in scores between two groups is significant.

¹³ df = degrees of freedom, p is the probability that the result is not trustworthy ($p < .05$ is deemed "significant").

¹⁴ Cohen's d -value is a measure of the size of the difference between groups ($d = .20$ is deemed a small difference, $d = .50$ is deemed a medium difference, and $d = .80$ is deemed a large difference).

the d -value indicated that the difference could be classified as between small and medium in size ($d = 0.37$). Hence, competence was perceived to be somewhat higher *within* than *across* PED-cells/operational components.

4.7 Trust

Trust was measured both pre and post exercise, in relation to both the respondents' own PED-cell/operational component (internal) and in relation to the other PED-cell/operational components (external).

As indicated above, the post-exercise survey was cut in length. For the trust measures, this meant that it was cut down from three to two items in the post-exercise metric. Table 4.1 (lines 9–14) indicates that the original three-item metric used to measure trust pre exercise demonstrated very good reliability, while reducing it to two items decreased the reliability. Post-exercise external trust reliability was slightly below acceptable reliability. Subsequent research should therefore strive to use the whole measure to ensure acceptable reliability. However, the mean values for pre-exercise internal trust based on two or three items were very close (0.01 difference for both internal and external trust). In order to compare the scores on the pre- and post-exercise measures, all the subsequent analyses are based on the same two-item measures.

The mean values in Table 4.1 (lines 9–4) indicate that the biggest differences in trust were between the pre- and post-exercise measures; post-exercise trust was lower than pre-exercise trust, especially the internal trust. The use of paired samples t -tests (Table 4.5) indicated that there was a significant difference between trust in own PED-cell/operational component compared to trust in other PED-cells/operational components pre exercise. Additionally, the paired samples t -tests indicated a significant difference between trust pre and post exercise in both trust in own PED-cell/operational component and trust in other PED-cell/operational components. Cohen's d was calculated for all the differences (Table 4.5), and indicated a large difference between trust in own PED-cell/operational component pre and post exercise. The size of the differences between trust in other PED-cells/operational components pre and post exercise could be regarded as medium – as was the difference between trust in own PED-cell/operational component compared to trust in other PED-cell/operational components pre exercise. Moreover, personnel in the UV18 exercise reported considerably more trust in their own PED-cell/operational component colleagues pre exercise compared to post exercise. They also reported quite a bit more trust in their colleagues from other PED-cells/operational components pre exercise compared to post exercise. Similarly, they reported quite a bit more trust in their own PED-cell/operational component colleagues than in their colleagues from other PED-cell/operational components post exercise.

Table 4.5 Paired samples t-test and Cohen's d: A comparison of trust assessed pre and post exercise ("preEx" and "postEx"), within ("internal") and across ("external") PED-cells/operational components (based on 2-item measures, i.e. comparable scores).

Trust compared between:	<i>M</i> diff	<i>SD</i> diff	<i>t</i>	<i>df</i>	<i>p</i> -value	<i>d</i> -value
PreEx: Internal and external trust	0.32	0.58	3.63	43	.001	0.55
PostEx: Internal and external trust	0.17	0.52	1.67	26	.107	0.32
Internal trust: PreEx and postEx	0.90	0.83	4.99	20	.000	1.09
External trust: PreEx and postEx	0.60	0.97	3.10	24	.005	0.62

Figure 4.1 portrays graphically the differences in trust assessed within and across PED-cells/operational components at two different times (pre and post exercise).

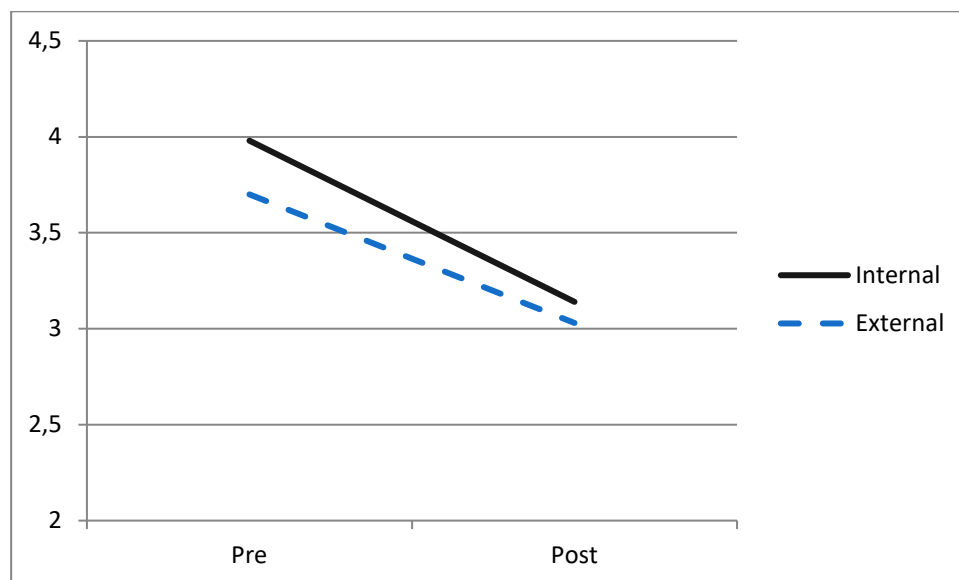


Figure 4.1 Internal and external trust assessed pre and post exercise.

4.8 Correlations

In order to do a first cut on the analyses of the relationship between the variables, a zero-order correlation analysis¹⁵ was performed. The results of this analysis are presented in Table 4.6.

The correlation matrix revealed some surprises compared to previous research. For instance, although not significant, there seemed to be a negative tendency in the correlations between the competence (internal and external) and the trust (internal and external, pre and post exercise)

¹⁵ A zero-order correlation analysis checks for relationships between two and two variables. The coefficients are standardized (i.e., between -1 and +1).

measures. Moreover, there was a tendency for competence to be negatively correlated with almost all of the other measures, especially the input measures. This means that when competence is high, most of the other measures are low, which is quite contrary to expectations based on theory and previous research.

The relationships shown in the correlation matrix provide further support for the decision to split up the flat structure measure described in Chapter 4.2 into in one single-item measure of flat structure and one four-item measure denoting few levels in the exercise; flat structure and few levels in the exercise demonstrate quite different relationships to the other variables. Indeed, many of the relationships of flat structure and few levels in the exercise are in the opposite direction.

Surprisingly, there was also found a negative tendency in the relationships between flat structure and the output variables, and decentralization and the output variables. The relationships between flat structure and decision making, and decentralization and decision making were significant, indicating that decision making was perceived to be better when the organization was perceived to be more hierarchic and centralized. There was found no significant correlations between alignment and the output measures, and there appeared to be no systematic tendency in the correlations.

The NFC-measure related about as expected to flat structure, information sharing, and the shared awareness measures (not significant, but positive tendency), whereas a weak negative tendency was found in relation to decentralization and decision making. Especially the latter negative tendencies were not as anticipated. NFC also demonstrated a negative tendency in its relationships to competence – significant between NFC and rated competence in other PED-cells/operational components. Hence, lower NFC was linked to higher ratings of competence. NFC showed a positive tendency in the relationships with the trust measures, of which its relationship to pre-exercise trust in own PED-cell/operational component was significant.

Although not significant, the obstacles to information sharing seemed to relate about as expected to the output measures (shared awareness, information sharing, and decision making) and trust – that is, negative relationships. This means that there was a tendency for the perception of less obstacles to co-occur with the perception of higher shared awareness, information sharing, and decision making (but this was not a significant finding).

Table 4.7 shows how power distance (Pd) and uncertainty avoidance (Ua) relate to the other variables. As indicated above, current data on Pd and Ua were unreliable due to the low *n* from each country. Hofstede's (2001) country mean values (as listed in Table 4.3) were therefore used to calculate the correlations between the cultural measures and the organizational and individual measures. The table reveals significant negative correlations between NFC and Pd, and NFC and Ua, indicating a tendency for people from countries with high Pd and Ua scored lower on NFC.

Table 4.6 Zero-order correlation coefficients.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Flat structure (single item)																	
2 Few levels in the exercise	<i>r</i>	-.312															
	<i>p</i>	.106															
3 Decentralized processes	<i>r</i>	.285	-.264														
	<i>p</i>	.127	.166														
4 Alignment	<i>r</i>	-.306	.013	.591**													
	<i>p</i>	.100	.949	.001													
5 Flexibility	<i>r</i>	.145	-.258	.135	.057												
	<i>p</i>	.445	.177	.469	.764												
6 NFC	<i>r</i>	.308	-.125	-.114	-.221	-.077											
	<i>p</i>	.174	.589	.612	.335	.734											
7 Int. competence	<i>r</i>	-.157	.151	-.051	-.208	-.492**	-.305										
	<i>p</i>	.407	.434	.786	.271	.005	.168										
8 Ext. competence	<i>r</i>	-.186	.404*	.032	-.003	-.263	-.444*	.569**									
	<i>p</i>	.324	.030	.866	.989	.153	.038	.001									
9 PreEx int. trust (2 items)	<i>r</i>	.196	.049	.311	.249	.404*	.502**	-.385	-.266								
	<i>p</i>	.348	.824	.130	.230	.045	.001	.057	.198								
10 PreEx ext. trust (2 items)	<i>r</i>	.358*	.133	.075	-.056	.312	.175	-.322	-.106	.746**							
	<i>p</i>	.079	.544	.723	.791	.129	.294	.116	.613	.000							
	<i>r</i>	.105	.056	-.132	.041	.242	.207	-.116	-.257	.395	.281						

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
11 PostEx int. trust (2 items)	<i>p</i>	.609	.790	.510	.841	.224	.411	.555	.196	.077	.218						
12 PostEx ext. trust (2 items)	<i>r</i>	-.068	-.120	-.085	.236	.224	-.100	.075	-.099	.264	.209	.743**					
	<i>p</i>	.721	.535	.648	.208	.225	.658	.688	.596	.203	.317	.000					
13 Obstacles to info. sharing	<i>r</i>	.081	-.201	.084	.101	.120	.003	-.154	.080	-.363	-.266	-.176	-.082				
	<i>p</i>	.675	.304	.660	.602	.528	.989	.415	.676	.081	.209	.391	.666				
14 Shared int. awaren. (3 it.)	<i>r</i>	.132	-.091	.086	.046	.026	.407	-.124	-.165	.319	.072	.445*	.236	-.187			
	<i>p</i>	.496	.644	.650	.813	.892	.060	.508	.383	.129	.737	.020	.209	.332			
15 Shared ext. awaren. (3 it.)	<i>r</i>	-.222	.176	-.321	-.143	.303	.033	-.100	.048	.203	.157	-.012	.012	-.067	.425*		
	<i>p</i>	.248	.371	.084	.459	.104	.886	.598	.801	.342	.465	.953	.950	.728	.022		
16 Info. sharing	<i>r</i>	-.649**	.227	-.441*	-.018	-.032	.198	.168	-.011	.136	-.047	.258	.319	-.338	.311	.537**	
	<i>p</i>	.000	.237	.013	.924	.862	.378	.358	.955	.517	.825	.185	.080	.068	.088	.002	
17 Decision making	<i>r</i>	-.280	.164	-.081	.179	.414*	-.177	.238	.275	.090	-.139	.336	.476*	.024	.061	.333	.532**
	<i>p</i>	.166	.433	.688	.381	.032	.469	.233	.165	.698	.548	.100	.012	.909	.766	.096	.004

Note. *r* = correlation coefficient. *p* = significance. *n* = 19-30. NFC = need for cognition.

Table 4.7 Zero-order correlation coefficients: Power distance (Pd) and uncertainty avoidance (Ua)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		Flat struct	Few levels	Dec. pros.	Align- ment	Flex.	NFC	Int. comp.	Ext. comp.	PreEx int. trust	PreEx ext. trust	PostEx int. trust	postEx ext. trust	Obstac. info. shar.	Shar int. awar.	Shar ext. awar.	Info. shar.	DM	Pd
17 Pd	<i>r</i>	.162	.136	.120	-.055	.203	-.340*	-.056	.165	-.153	.075	-.025	.015	-.273	-.050	-.062	-.120	.134	
	<i>p</i>	.394	.481	.521	.773	.274	.032	.761	.376	.315	.622	.900	.935	.144	.790	.743	.512	.505	
18 Ua	<i>r</i>	.232	.050	.290	.072	.232	-.325*	-.064	.149	.021	.175	-.209	-.050	-.109	.175	.143	-.245	-.076	.593**
	<i>p</i>	.218	.798	.113	.703	.209	.041	.728	.425	.892	.250	.285	.788	.565	.347	.450	.177	.705	.000

Note. This correlation analysis is based on Hofstede's (2001) scores on power distance (Pd) and uncertainty avoidance (Ua). $n = 29-53$. NFC = need for cognition, DM = decision making.

4.9 Moderator analyses

The presented theory suggested moderator effects of alignment, trust, competence, Pd, and Ua on the effects of flat structure and decentralization (i.e., the independent variables) on flexibility (i.e., mediator), and shared awareness, information sharing, and decision making (i.e., the organizational effectiveness measures/dependent variables). For instance, as indicated in the theory section, Pd and Ua were anticipated to moderate the effects of organizational structure and processes on the organizational effectiveness variables. This means that the effectiveness of for instance flat structure and decentralized processes was expected to be dependent on the cultural context being low Pd and Ua. Because the competence variable had been abbreviated from a four-item measure to a single-item measure that did not relate to the other measures as anticipated, indicating hampered validity and reliability, competence was not included in the moderator analyses.

The variable scores were first mean centered, then the interaction terms were calculated, before the terms were included in the regression analyses (see e.g. Aiken & West, 1991). The moderator effects all proved nonsignificant and are therefore not described any further. The lack of significant moderator effects was not surprising considering the small sample size (McClelland & Judd, 1993).

5 Discussion

5.1 Descriptive and comparative analyses

The descriptive analyses demonstrated that trust and decision making obtained the highest scores (a bit above average), and flat structure (single item) and obstacles to information sharing the lowest scores (a bit below average).

This means that decision making was perceived quite positively by the personnel in the UV18 exercise, in terms of the pace and the success of the decisions made. The structure of the organization was viewed as more hierarchic than flat. The item details of the obstacles to information sharing measure indicated that the approachability of the commander, political constraints, and document classification did not represent much hindrance to information sharing in the exercise. However, technical difficulties and procedural inefficiencies obtained over average scores, indicating more important hindrances to information sharing. Hence, for future UV trials the results suggest there is room for improvement within the technological solutions and procedures used.

The above average scores on trust indicated generally good trust in other exercise personnel. Results further indicated that personnel in the UV18 exercise trusted their colleagues both within and in other PED-cells more pre exercise than post exercise. There was also a difference in trust between the scores from within and across PED-cells in favor of own PED-cell. The difference was, however, only significant pre exercise. Moreover, the results suggest that the personnel's expectations towards both members of own cell and other cells were more positive than their subsequent experiences. The personnel's higher expectations towards members of own cell relative to other cells prior to the exercise, demonstrates ingroup favoritism (e.g., Tajfel, 1970, 1981; Brewer, 1979). On the positive side, ingroup favoritism was lowered by actual experiences. On the negative side, trust overall was lowered by actual experiences. Because trust has been found to be positively affected by team training (Prichard & Ashleigh, 2007), including in global virtual teams (Jarvenpa, Knoll, & Leidner, 1998), the fact that trust was lower post exercise than pre exercise suggests that personnel experienced incidents that lead to lowered trust. It is proposed that future research look more closely into the details of such experiences, and address what can be done to amend the issues that lead to lowered trust both within and across PED-cells.

Similar to the case of trust, results indicated that personnel perceived that colleagues within their own PED-cell were somewhat more competent than their colleagues in other PED-cells. The level of shared awareness was also rated higher within than across cells (classified as a medium sized difference). These results from the comparative analyses (i.e., on trust, competence, and shared awareness), within versus across PED-cells, all suggest the same – that there is a more positive perception of the personnel and processes from within the PED-cell compared with the perception of other PED-cells. This is, as indicated above, a classic finding of ingroup favoritism (e.g., Tajfel, 1970, 1981; Brewer, 1979).

5.2 Reliability analyses

The reliability analyses indicated between acceptable and very good reliability for all the measures except flat structure, flexibility, trust assessed by two items, and shared awareness assessed by three items.

A follow-up more in-depth reliability analysis indicated that the five-item measure of flat structure needed to be divided into a single-item measure that was understood to measure flat structure (comparable to the single-item metric used in Bjørnstad, 2011), and a four-item measure that was understood to assess the perceived number of levels included in the exercise. Moreover, the analysis had demonstrated a negative item-total correlation between the flat structure item and the other four (perceived-number-of-levels-included-exercise) items, an indication that the items did not measure the same construct. Supporting the decision to split the measure in two parts was that flat structure (and decentralization) demonstrated a negative tendency in the relationships to the output variables, whereas few levels included in the exercise demonstrated a positive tendency. In other words, there was a trend in the data for flat structure (and decentralization) to be linked to lower organizational effectiveness and few levels included in the exercise to be linked to higher organizational effectiveness. However, as only one of these

relationships proved significant (i.e., between flat structure and information sharing), these results should be interpreted with care.

Decentralization showed good reliability, while flexibility was just below the .70 limit for acceptable reliability. As indicated in the method section, on site changes blurring the meaning of these measures made the results less interpretable. The lowered reliability scores could thus be due to the changes in the measures, compared to the original measure validated in previous research from military contexts (e.g., Bjørnstad & Elstad, 2015).

The results from the reliability analysis suggested that the full measure of trust (three items) is preferable in future research. However, comparing the results in the correlation analysis revealed only trivial differences between the three- and two-item measures. Hence, the measure seemed to have largely maintained predictive validity.

The reliability analysis indicated below acceptable reliability for the shortened shared awareness measure (i.e., the four-item measure of shared external awareness was shortened to a three-item measure in UV18), suggesting future research should use the full shared awareness measure (the full measure was used for measuring shared internal awareness, which demonstrated acceptable reliability). However, comparing the results in the correlation analysis revealed only trivial differences between a four- and a three-item measure, suggesting that the predictive validity may have been maintained despite the low reliability score.

It was pointed to above that personnel perceived that colleagues within their own PED-cell were somewhat more competent than their colleagues in other PED-cells. However, as the measure was cut from a four-item measure to a single-item measure in UV18, these results are somewhat unsure and should be interpreted with care. The correlation analyses did not clarify the matter – many relations were not as expected. There was found a negative tendency in almost all the relationships to competence, even to the trust measures, which was quite surprising. Based on previous theory and empirical research, the relationship between competence and trust was expected to be positive (Bjørnstad & Ulleberg, Submitted). This suggests that the truncation may have compromised the measure's predictive and content validity. Hence, it is strongly advised that future research in military ISR and C2 contexts use the original measure.

There were too few respondents to reliably calculate the country level power distance (Pd) and uncertainty avoidance (Ua). Values from previous research (Hofstede; 2001) were therefore used in order to calculate any relationships between the cultural constructs and the organizational and individual constructs.

5.3 Correlation analyses

The correlation analyses produced both results that were surprising and results that were unsurprising according to the theory and previous research visualized in the conceptual model (Figure 2.1).

The organizational effectiveness measures seemed to relate to each other about as expected; decision making and information sharing were positively related, and shared external awareness and information sharing were positively related. Although not quite significant ($p < .10$), there was also a positive tendency in the relationship between shared external awareness and decision making. Shared internal awareness also demonstrated a positive tendency in the relationship to information sharing, but there was no relationship with decision making.

In line with previous research, the correlation analyses also suggested a positive relationship between trust and organizational effectiveness. This indicates that trust may be important to foster in the organization both within and across PED-cells –in order to give the best organizational output.

The tendency in the relationships between obstacles to information sharing and the output measures (shared awareness, information sharing, and decision making), and between obstacles to information sharing and the trust measures seemed to be about as expected; although not significant, the tendency was negative (i.e., for obstacles to information sharing to be linked to low trust and low organizational effectiveness). There seemed to be no relationships between obstacles and the input measures. Follow-up research may also look more into the details of the components of the obstacles measure, to see whether there are differences in how the various obstacles are related to the input measures as well as in how they influence the output measures.

The NFC-measure related about as expected to flat structure, information sharing, and the shared awareness measures (not significant, but a positive tendency), whereas a weak negative tendency was found in relation to decentralization and decision making. Especially the latter negative tendencies were not as anticipated. Cultural aspects may also play a part here. This needs also to be further analyzed in future research in military C2 and ISR contexts. The NFC-measure furthermore demonstrated a negative relationship with the rating of competence in other PED-cells and a positive relationship to the pre-exercise trust in own PED-cell. There were no specific expectations or hypotheses linked to these latter findings.

The negative correlations between the input measures flat structure and decentralized processes on one side, and the output measure information sharing on the other, were also quite surprising compared to previous research (e.g., Bjørnstad, 2011). Because cultures that are high in Pd and Ua have been linked to people being used to and preferring more hierarchic and centralized types of organization (e.g., Hofstede 2001), cultural differences in Ua and Pd in the samples may explain the surprising findings. Moderator analyses were conducted, but did not produce any significant results. Due to the small sample size, this was not considered a surprise. Changes in the flat structure, decentralized processes, flexibility, and decision-making metrics may also be part of the picture. Follow-up analyses and future research in military C2 and ISR contexts should look into these matters.

The significant correlations between NFC and Pd, and NFC and Ua indicate that cultural differences may have an impact on the tendency for the individuals in a society to like to think in depth about issues. Authoritarian and rule-based parenting more common in high Pd and Ua

cultures may cause less motivation to think in depth about issues, because there is less room for individual thinking and initiative. This finding supports the theoretical propositions in Bjørnstad (2019) and in this report.

In sum, some of the surprises in the correlation matrix may certainly be attributed to the changes made to the metrics as used in the UV18 exercise, while others may be due to differences in the organizational settings and the samples included in the different research. Many moderating and mediating factors such as cultural differences may also have had an impact on the relationships. Due to the small sample size, these results were considered inconclusive.

5.4 Implications for C2 and ISR decision makers

Decision making is an output measure that taps into the perception of the C2 processes. The above presented results indicated that personnel in the UV18 exercise perceived the pace and success of decisions quite positively. This implies that the decision-makers generally had the means and capacity to make timely and good decisions. Although the scores were above average (e.g., almost reaching the “quite successful” score), there is still room for improvement. In line with previous research from military settings, information sharing was found to be positively linked to decision making, and shared awareness was positively linked to information sharing. These relationships may suggest a mediation effect, where a shared understanding of roles and responsibilities is important to the efficient sharing of information, both within and across PED-cells. This underscores the importance of facilitating information sharing and a shared awareness and understanding of the roles and responsibilities both within and across PED-cells to assure the effectiveness of the organization’s C2 and ISR decision-making processes.

There was found a medium sized difference between shared awareness within compared to across PED-cells. This implies that although the shared awareness was rated a bit above average across PED-cells, there was more room for improvement in clarifying roles and responsibilities across than within the PED-cells. This may be important to have in mind both when preparing for future ISR exercises and when aiming to improve the daily ISR and C2 processes.

In line with previous research from military settings, trust was found to be positively related to decision making and shared awareness. More specifically, trust within the PED-cells (assessed post exercise) was significantly related to shared awareness within the PED-cells, and trust across PED-cells (assessed post exercise) was significantly related to decision making. These results imply that trust both within and across PED-cells is vital for ISR and C2 processes. Hence, in order to improve ISR and C2 processes, building trust within and across PED-cells seems to be a take-home message from the current results. Also, because there was found a medium sized difference in trust within compared to across PED-cells pre exercise, it may be advisable to pay extra attention to the building of trust across PED-cells. The large difference in trust pre as opposed to post exercise implied that the actual experiences that the personnel made when cooperating during the exercise, lead to lowered trust both within and across PED-cells. The data did not reveal the reason for this decline, but it is suggested that this finding is

examined in future research. It may also be a good idea for decision makers in the ISR organization to look into such matters – in order to rectify or minimize the experiences that led to the lowering of trust between colleagues during the UV18 exercise.

Similar to trust, shared awareness, and competence were also rated lower across than within PED-cells. It is deemed vital that decision-makers in C2 and ISR are aware of this basic human tendency to focus on and be more positive towards their own group (e.g., Tajfel, 1970, 1981). Being aware of this tendency towards ingroup favoritism may allow measures to be taken to counteract it. For instance, building relations, positive experiences, and identities across groups, may be examples of such measures (se e.g., Bjørnstad 2019, for an overview).

In terms of the organizational structure and processes, the results were inconclusive. Due to the changes made to these measures, and the indications of hampered reliability and validity, there are no clear implications on organizational structure and processes for C2 and ISR. However, compared to previous research, the relationships to information sharing appeared to be in the opposite direction, indicating that hierarchical structure and centralized processes were beneficial to the sharing of information in this ISR organization. On the other hand, perceiving the number of hierarchic levels (i.e., command and decision-making levels) included in the exercise to be few rather than many showed a positive tendency in the relationship to information sharing (not significant). These results may indicate that the systems for sharing information in this ISR exercise, whether technological, procedural, or organizational, may simply have been set up for a hierarchic and centralized information sharing. This interpretation may be seen as being supported by the finding that technical difficulties and procedural inefficiencies were rated the most important hindrances to information sharing (rated between “sometimes” and “often” on average). Additionally, mismatches between real world processes and the simulated processes was rated the third most important hindrance to information sharing (rated just above “sometimes” on average). Hence, for future UV trials the results suggest there is room for improvement within the technological solutions and procedures used. However, as indicated above, differences in culture (Pd and Ua) and in the metrics in the current compared to previous research, may also have produced the differences in results. Therefore, it is simply recommended that future C2 and ISR research further look into these matters.

The approachability of the commander, political constraints, and document classification did not seem to represent much hindrance to information sharing in the exercise. Hence, decision-makers in ISR may consider these issues a success in the UV18 exercise.

Finally, the negative relationships found between NFC and Pd, and NFC and Ua indicate that cultural differences may have an impact on the tendency for the individuals in a society to like to think in depth about issues. The implication for C2 and the organization of ISR is that more rule-based and centralized organizational and decision making processes may foster and select individuals that are less motivated to think in depth about issues, because there is less room for individual thinking and initiative in such organizations. This suggests that a democratization of C2 (i.e., decentralizing decision-making and empowering the lower levels), allowing for more individual thinking and initiative, may be advantageous for the propensity of the personnel to think in depth about issues in their everyday job. This propensity may in turn be advantageous

for the organization's problem-solving and decision-making ability – especially in the context of cyber and hybrid threats, as suggested in Bjørnstad (2019). However, these interpretations need to be further investigated in future research.

5.5 Limitations and future research

As indicated above, we had a limited sample, which put some restrictions on the analyses possible. With only a few respondents from each of the participating countries the cultural measures Pd and Ua could not be reliably calculated. Moderator analyses were conducted, but the lack of significant results were not a surprise considering the sample size. It is suggested that follow-up research with larger samples further test for moderator effects and also calculate differences in Pd and Ua. With more ample data material in future research one may also test the entire organizational model in a military C2 and ISR context. In this initial study, the conceptual model was included to visualize the theoretical and empirical background of the current research.

The findings presented in this report reflects the participants' perceptions of organizational and related factors, they do not represent any objective reality. Perceptions are nevertheless relevant, as perceptions spur human evaluation and behavior. Indeed, perceptions are at the basis of an extensive part of human factors research.

There were made changes to the questionnaires on site. This meant a shortening of the post-exercise questionnaire, so that some measures were cut altogether, while others were abbreviated, and some altered. It was deemed that many of these changes may have hampered the validity and reliability of the measures, and it is therefore advised that future research in military ISR and C2 contexts use the original measures.

In the HFM-276 report there will be presented descriptive analyses of additional data from another venue (Bold Quest 2019). But with a sample size considerably inferior of the UV18 sample size these analyses will be limited to descriptive statistics. However, the metrics used in Bold Quest did not suffer the changes that may have hampered the validity and reliability of many of the organizational measures, and may be considered an interesting opportunity for comparing the results.

5.6 Closing remarks

In order to better understand the organizational, cultural and individual issues related to ISR and C2 in a military context, HFM-276 developed a survey instrument and data were collected before, under, and after the ISR exercise UV18. This report has presented the statistical analysis of the individual, organizational and cultural data, including descriptive statistics, reliability analyses, correlation analyses, and moderator analyses. A complete presentation of the analyses of all the data from UV18 collected by HFM-276 will be published in the NATO final report of HFM-276, which is currently in progress and due by the Spring of 2020.

The results highlighted the importance of facilitating information sharing and the understanding of roles and responsibilities both within and across the organizational components (i.e., PED-cells) analyzed, to assure the effectiveness of the organization's C2 and ISR decision-making processes. The results furthermore suggested that commanders need to pay special attention to building trust and understanding across organizational components to improve the C2 effectiveness in ISR operations. Finally, the results implied that there is room for improvement in future UV trials pertaining to the technological solutions and procedures used.

The research reported here is deemed useful for military decision-makers and researchers in ISR, C2, and human factors related research. The theory and results may improve the general understanding of individual, organizational, and cultural issues relevant for improving the effectiveness of military C2 and ISR. The method expands the available metrics for collecting relevant data to improve our knowledge of human issues related to C2 in ISR operations both nationally and internationally.

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Abbreviations

α	Cronbach's alpha (reliability)
BISK	Bistand til Forsvaret og Forsvarsdepartementet innen strategisk kommunikasjon
C2	command & control
CD&E	concept development and experimentation
d	Cohen's d-value
df	degrees of freedom
FOH	Norwegian Armed Forces Head Quarter
HF	human factors
HQ	head quarter
ISR	intelligence, surveillance and reconnaissance
JI	job involvement
JISR	joint intelligence, surveillance and reconnaissance
K2	Kommando, kontroll og teknologi i fellesoperasjoner
M	mean
N	number of responses
HFM	Human Factors and Medicine
NFC	need for cognition
p	probability (i.e., that the result is not trustworthy)
PED	processing, exploiting, and disseminating
Pd	power distance
r	correlation coefficient
RO	rank order

RTG	Research and Technology Group
<i>SD</i>	standard deviation
STO	Science and Technology Organization
TCPED	tasking, collecting, processing, exploiting, and disseminating
<i>t</i>	paired samples t-test (result)
Ua	uncertainty avoidance
USAFE WPC	United States Air Forces Europe Warrior Preparation Centre
UV18	Unified Vision 2018

A Surveys

A.1 Pre exercise survey (complete)

Trust
How confident are you that:
1. Very confident 2. Confident 3. Neutral 4. Doubtful 5. Very doubtful
Your colleagues in <i>your nation/PED-cell</i> will share important information with you?
Your colleagues in your nation/PED-cell will assist you when you need help?
Your colleagues in your nation/PED-cell will fulfill their responsibilities?
Your colleagues in <i>other nations/PED-cells</i> will share important information with you?
Your colleagues in other nations/PED-cells will assist you when you need help?
Your colleagues in other nations/PED-cells will fulfill their responsibilities?
Cognition (NFC)
1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree
I would prefer complex to simple problems.
I like to have the responsibility of handling a situation that requires a lot of thinking.
Thinking is not my idea of fun.*
I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.*
I try to anticipate and avoid situations where there is likely chance I will have to think in depth about something.*
I find satisfaction in deliberating hard and for long hours.
I only think as hard as I have to.*
I prefer to think about small, daily projects to long-term ones.*
I like tasks that require little thought once I've learned them.*
The idea of relying on thought to make my way to the top appeals to me.
I really enjoy a task that involves coming up with new solutions to problems.
Learning new ways to think doesn't excite me very much.*
I prefer my life to be filled with puzzles that I must solve.
The notion of thinking abstractly is appealing to me.
I would prefer a task that is intellectual, difficult and important to one that is somewhat important but does not require much thought.

I feel relief rather than satisfaction after completing a task that required a lot of mental effort.*
It's enough for me that something gets the job done; I don't care how or why it works.*
I usually end up deliberating about issues even when they do not affect me personally.
Culture: Please think of an ideal job, disregarding your present job, if you have one. In choosing an ideal job, how important would it be to you to ... (please choose one answer in each line across): 1. Of utmost importance 2. Very important 3. Of moderate importance 4. Of little importance 5. Of very little or no importance
have a boss (direct superior) you can respect
be consulted by your boss in decisions involving your work
How often, in your experience, are subordinates afraid to contradict their boss? 1. Never 2. Seldom 3. Sometimes 4. Usually 5. Always
To what extent do you agree or disagree with each of the following statements? (please choose one answer in each line across): 1. Strongly Agree 2. Agree 3. Neutral 4. Disagree 5. Strongly Disagree
An organization structure in which certain subordinates have two bosses should be avoided at all cost
One can be a good manager without having a precise answer to every question that a subordinate may raise about his or her work
A company's or organization's rules should not be broken - not even when the employee thinks breaking the rule would be in the organization's best interest
How often do you feel nervous or tense? 1. Always 2. Usually 3. Sometimes 4. Seldom 5. Never
All in all, how would you describe your state of health these days? 1. Very good 2. Good 3. Fair 4. Poor 5. Very poor

A.2 Pre exercise survey (actual)¹⁶

Trust

Your colleagues in your nation/PED-cell will share important information with you?

Your colleagues in your nation/PED-cell will assist you when you need help?

Your colleagues in your nation/PED-cell will fulfil their responsibilities?

Your colleagues in other nations/PED-cells will share important information with you?

¹⁶ Response categories as in A.1.

Your colleagues in other nations/PED-cells will assist you when you need help?

Your colleagues in other nations/PED-cells will fulfil their responsibilities?

NFC

I would prefer complex to simple problems.

I like to have the responsibility of handling a situation that requires a lot of thinking.

Thinking is not my idea of fun. REC

I would rather do something that requires little thought than something that is sure to challenge my thinking abilities. REC

I try to anticipate and avoid situations where there is likely chance I will have to think in depth about something. REC

I find satisfaction in deliberating hard and for long hours.

I only think as hard as I have to. REC

I prefer to think about small, daily projects to long-term ones. REC

I like tasks that require little thought once I've learned them. REC

The idea of relying on thought to make my way to the top appeals to me.

I really enjoy a task that involves coming up with new solutions to problems.

Learning new ways to think doesn't excite me very much. REC

I prefer my life to be filled with puzzles that I must solve.

The notion of thinking abstractly is appealing to me.

I would prefer a task that is intellectual, difficult and important to one that is somewhat important but does not require much thought.

I feel relief rather than satisfaction after completing a task that required a lot of mental effort. REC

It's enough for me that something gets the job done; I don't care how or why it works. REC

I usually end up deliberating about issues even when they do not affect me personally.

Power Distance

Disregarding your present job, in choosing an ideal job, how important would it be to you to have a boss (direct superior) you can respect?

Disregarding your present job, in choosing an ideal job, how important would it be to you to be consulted by your boss in decisions involving your work?

How often, in your experience, are subordinates afraid to contradict their boss?

An organization structure in which certain subordinates have two bosses should be avoided at all cost.

Uncertainty Avoidance

One can be a good manager without having a precise answer to every question that a subordinate may raise about his or her work.

A company's or organization's rules should not be broken - not even when the employee thinks breaking the rule would be in the organization's best interest.

How often do you feel nervous or tense?

All in all, how would you describe your state of health these days?

A.3 Post exercise survey (complete)

Based on your experiences in JISR operations, please respond to the following statements by placing the number next to the response that best describes your opinion or situation: 1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree
Organizational structure 1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree
Work in this exercise organization is concentrated within few hierarchical levels.
There are few decision-making levels in this exercise organization.
The information needs to travel through few hierarchic levels in this exercise organization.
Responsibility is distributed on a few hierarchic levels in this exercise organization.
From your standpoint in this exercise, how would you describe the organizational structure in general? 1. Very hierarchical 2. Hierarchical 3. Neither hierarchical nor flat 4. Flat 5. Very Flat

<p>Organizational processes</p> <p>From your standpoint in this exercise, how would you describe the following organizational processes in terms of centralization/decentralization?</p> <p>1. Very centralized 2. Centralized 3. Neither centralized nor decentralized 4. Decentralized 5. Very decentralized</p>
Work processes.
Decision processes.
Information sharing processes.
Distribution of responsibilities.
Processes in general.
<p>Flexibility</p> <p>From your standpoint in this exercise, how would you describe the following organizational processes in terms of rigidity/flexibility?</p> <p>1. Very rigid 2. Rigid 3. Neither rigid nor flexible 4. Flexible 5. Very Flexible</p>
Work processes.
Decision processes.
Information sharing processes.
Distribution of responsibilities.
Processes in general.
<p>Obstacles to information sharing</p> <p>From your standpoint, how often do the following conditions represent obstacles to information sharing during this exercise?</p> <p>1. Never 2. Rarely 3. Sometimes 4. Often 5. Very Often</p>
Technical difficulties.
Procedural inefficiencies
Low English proficiency of participants.
Differences between PED-cells.
Differences in national culture
Time constraints.
Approachability of the commander.
Lacking knowledge about who needs the information.

Differing priorities.
Political constraint/control.
Security issues.
Document classification.
System classification.
Mismatch between the actual work processes and the work processes embedded in the collaborate technology.
Information sharing Indicate which answer best describes your perception based on the role that you have in this exercise:
1. Very content 2. Somewhat content 3. Neutral 4. Somewhat discontent 5. Very discontent
How content are you with the amount of information that you receive?
How content are you with the contents of the information that you receive?
How content are you with the information that you give overall?
Shared awareness of tasks and responsibilities Indicate to what degree you agree or disagree with the following statements based on the role that you have in this exercise:
1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree
In <i>our nation/PED-cell</i> , we often experience misunderstandings with each other.
In our nation/PED-cell, we are aware of each other's areas of responsibility.
In our nation/PED-cell, we are unsure about how to execute shared tasks with each other.
In our nation/PED-cell, we do not know each other's roles pertaining to executing shared tasks.
In our nation/PED-cell, we often experience misunderstandings with <i>other nations/PED-cells</i> .
Our nation/PED-cell and the other nations/PED-cells are aware of each other's areas of responsibility.
In our nation/PED-cell, we are often unsure about how to execute shared tasks with other nations/PED-cells.
Our nation/PED-cell and the other nations/PED-cells do not know what each others' roles are in relation to executing shared tasks.
In the joint task force headquarter the teams/functions (J2, J3 etc.) worked together in a well-coordinated fashion.
Decision making Indicate which answer best describes your perception based on the role that you have in this exercise:

To what degree are decisions made too fast/slow or in a perfect pace? 1. Far too slow/fast 2. Too slow/fast 3. Somewhat too slow/fast 4. A bit too slow/fast 5. Perfect pace
How do you perceive the decision quality? 1. Very good 2. Quite good 3. Neither good nor poor 4. Quite poor 5. Very poor
How successful do you perceive decisions to be? 1. Very successful 2. Quite successful 3. Neither successful nor unsuccessful 4. Quite unsuccessful 5. Very unsuccessful
Trust How confident have you been that: 1. Very confident 2. Confident 3. Neutral 4. Doubtful 5. Very doubtful
Your colleagues in <i>your nation/PED-cell</i> share important information with you?
Your colleagues in your nation/PED-cell assist you when you need help?
Your colleagues in your nation/PED-cell fulfill their responsibilities?
Your colleagues in <i>other nations/PED-cells</i> share important information with you?
Your colleagues in other nations/PED-cells assist you when you need help?
Your colleagues in other nations/PED-cells fulfill their responsibilities?
Competence Please relate to the current exercise and indicate to what degree you agree or disagree with the following statements: 1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree
We, in <i>our nation/PED-cell</i> , experience that <i>we</i> have the necessary competence to perform our work.
We, in our nation/PED-cell, experience that everyone in our nation/PED-cell know their job.
We, in our nation/PED-cell, experience that everyone in our nation/PED-cell understand how our work is contributing to the JISR processes.
We, in our nation/PED-cell, have a good understanding of the current JISR processes.
We, in our nation/PED-cell, experience that <i>other nations/PED-cells</i> have the necessary competence to perform their work.
We, in our nation/PED-cell, experience that other nations/PED-cells know their job.
We, in our nation/PED-cell, experience that other nations/PED-cells understand how their work is contributing to the JISR processes.
We, in our nation/PED-cell, experience that other nations/PED-cells have a good understanding of the current JISR processes.
Job involvement

<p>Please state; in what degree do you:</p> <p>1. In a very low degree 2. In a low degree 3. In a medium degree 4. In a high degree 5. In a very high degree</p>
Experience that the Ped cell/National products are important to you?
Experience that the UV18 outcomes are important to you?
Feel responsible for the Ped cell/National products?
Feel responsible for the UV18 outcomes?
Feel motivated to go out of your way to contribute to the Ped cell/National products?
Feel motivated to go out of your way to contribute to the UV18 outcomes?

A.4 Post exercise survey (actual)¹⁷

Organizational Structure

Work in this trial's organizational structure is concentrated within few hierarchical levels.

There are few decision-making levels within this trial's organizational structure.

Information needs to travel through few hierarchical levels in this trial's organizational structure.

Responsibility is distributed across a few hierarchical levels in this trial's organizational structure.

In general, how would you describe the organizational structure in this trial?

Organizational Processes: Decentralization

In terms of centralization/decentralization, how would you describe the work processes within this trial's organizational structure?

In terms of centralization/decentralization, how would you describe the decision processes within this trial's organizational structure?

In terms of centralization/decentralization, how would you describe the information sharing processes within this trial's organizational structure?

¹⁷ Response categories as in A.3, with the exception of decision making. The response categories for decision making were: 1. Too slow, 2. Somewhat too slow, 3. Perfect pace, 4. Somewhat too fast, 5. Too fast.

In terms of centralization/decentralization, how would you describe the distribution of responsibilities within this trial's organizational structure?

Flexibility

In terms of rigidity/flexibility, how would you describe the work processes within the trial's organizational structure?

In terms of rigidity/flexibility, how would you describe the decision processes within this trial's organizational structure?

In terms of rigidity/flexibility, how would you describe the information sharing processes within this trial's organizational structure?

In terms of rigidity/flexibility, how would you describe the distribution of responsibilities within this trial's organizational structure?

Obstacles to information sharing

How often did technical difficulties represent an obstacle to information sharing during this trial?

How often did procedural inefficiencies represent an obstacle to information sharing during this trial?

How often did low English proficiency of participants represent an obstacle to information sharing during this trial?

How often did differences between PED-cells/operational components represent an obstacle to information sharing during this trial?

How often did differences in national culture represent an obstacle to information sharing during this trial?

How often did time constraints represent an obstacle to information sharing during this trial?

How often did the approachability of the commander represent an obstacle to information sharing during this trial?

How often did lacking knowledge about who needs the information represent an obstacle to information sharing during this trial?

How often did differing priorities represent an obstacle to information sharing during this trial?

How often did political constraints/control represent an obstacle to information sharing during this trial?

How often did security issues represent an obstacle to information sharing during this trial?

How often did document classification represent an obstacle to information sharing during this trial?

How often did system classification represent an obstacle to information sharing during this trial?

How often did mismatches between real world processes and the simulated processes represent an obstacle to information sharing during this trial?

Information Sharing

How content are you with the amount of information that you received?

How content are you with the contents of the information that you received?

How content are you with the information that you shared?

Shared Awareness of tasks and responsibilities

In our PED-cell/Operational component, we often experienced misunderstandings with each other.

In our PED-cell/Operational component, we were aware of each other's areas of responsibility.

In our PED-cell/Operational component, we were unsure about how to execute shared tasks with each other.

In our PED-cell/Operational component, we did not know each other's roles pertaining to executing shared tasks.

In our PED-cell/Operational component, we often experienced misunderstandings with other PED-cells/Operational components.

Our PED-cell/Operational component and the other PED-cells/Operational components were aware of each other's areas of responsibility.

Our PED-cell/Operational component and the other PED-cells/Operational component did not know what each other's roles are in relation to executing shared tasks.

Decision making

From the perspective of your position, at what pace were decisions made?

From the perspective of your position, how do you perceive the success of the decisions made?

Trust

How confident are you that your colleagues in your PED-cell/Operational component shared important information with you?

How confident are you that your colleagues in your PED-cell/Operational component assisted you when you needed help?

How confident are you that your colleagues in other PED-cells/Operational component shared important information with you?

How confident are you that your colleagues in other PED-cells/Operational components assisted you when you need help?

Competence

In our PED-cell/Operational component, we have the necessary competence to perform our work.

The members of other PED-cells/Operational components have the necessary competence to do their work.

About FFI

The Norwegian Defence Research Establishment (FFI) was founded 11th of April 1946. It is organised as an administrative agency subordinate to the Ministry of Defence.

FFI's MISSION

FFI is the prime institution responsible for defence related research in Norway. Its principal mission is to carry out research and development to meet the requirements of the Armed Forces. FFI has the role of chief adviser to the political and military leadership. In particular, the institute shall focus on aspects of the development in science and technology that can influence our security policy or defence planning.

FFI's VISION

FFI turns knowledge and ideas into an efficient defence.

FFI's CHARACTERISTICS

Creative, daring, broad-minded and responsible.

Om FFI

Forsvarets forskningsinstitutt ble etablert 11. april 1946. Instituttet er organisert som et forvaltningsorgan med særskilte fullmakter underlagt Forsvarsdepartementet.

FFIs FORMÅL

Forsvarets forskningsinstitutt er Forsvarets sentrale forskningsinstitusjon og har som formål å drive forskning og utvikling for Forsvarets behov. Videre er FFI rådgiver overfor Forsvarets strategiske ledelse. Spesielt skal instituttet følge opp trekk ved vitenskapelig og militærteknisk utvikling som kan påvirke forutsetningene for sikkerhetspolitikken eller forsvarsplanleggingen.

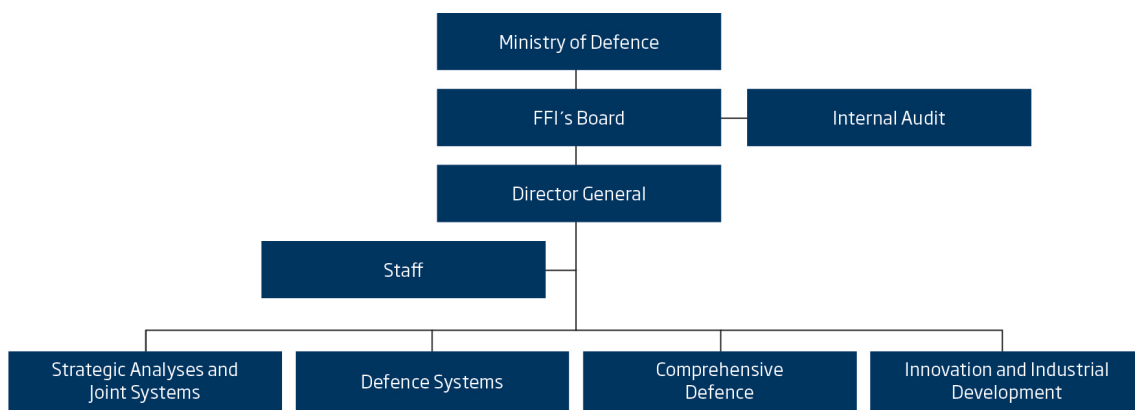
FFIs VISJON

FFI gjør kunnskap og ideer til et effektivt forsvar.

FFIs VERDIER

Skapende, drivende, vidsynt og ansvarlig.

FFI's organisation



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